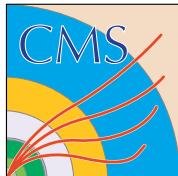


**PRS: Physics Reconstruction and Selection  
HCAL/JetsMET group**

# **HCAL Calibration**

**Shuichi Kunori  
U. of Maryland  
20-Feb-2002**



# Data Flow

>>> front end <<<

## Scint. Lights

->Tile->Fiber1&2->OptCable  
->HPD->Amp->ADC->

## Charge (for 5-10xings)

->(L1Path)  
->(DAQPath)

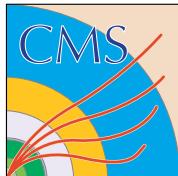
>>> L1Path <<<

->**HTR (ch)**  
**E<sub>T</sub>(L1Primitive: 8bits:non-linear)**  
->**L1 LUT (ch)**  
**E<sub>T</sub>(4x4 HcTower: 8bits:linear)**  
->**L1Calo**  
**E<sub>T</sub>(L1jets),Et(L1tau),Et(L1MET)**  
->**L1CaloGlobal(Threshold (obj))**  
->**L1Global**  
**L1Trigger**

>>> after DAQPath <<<

->**ReadoutAnalyzer (ch)**  
**E<sub>T</sub>(channel)**  
->**TowerCreator**  
**E<sub>T</sub>(Ec+Hc Tower)**  
->**Jet/MET/tauReco**  
**E<sub>T</sub>(jetR),Et(tauR),Et(METR)**  
->**EtCaloCorrection (obj)**  
(corr. for linearity)  
**E<sub>T</sub>(JetC),Et(tauC),Et(METC)**  
->**EtPhysCorrection (obj)**  
(corr. for out-of-cone)  
**E<sub>T</sub>(Parton)**

Calibration/correction  
**(ch)** - channel by channel  
**(obj)** - phys. Obj, (jet, tau, MET)



# Calibration - Tools

## A) Megatile scanner:

- Collimated Co<sup>60</sup> gamma source
- each tile: light yield
- during construction  
all tiles

## B) Moving radio active source:

- Co<sup>60</sup> gamma source
- full chain: gain
- during CMS-open (manual)  
all tiles
- during off beam time (remote)  
tiles in layer 0 & 9

## C) UV Laser:

- full chain: timing, gain-change
- during off beam time  
tiles in layer 0 & 9  
all RBX

## D) Blue LED:

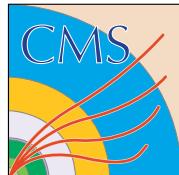
- timing, gain change
- during the off beam time  
all RBX

## E) Test beam

- normalization between  
GeV vs. ADC vs. A,B,C,D
- ratios: elec/pion, muon/pion
- pulse shape/time structure
- before assembly  
a few wedges

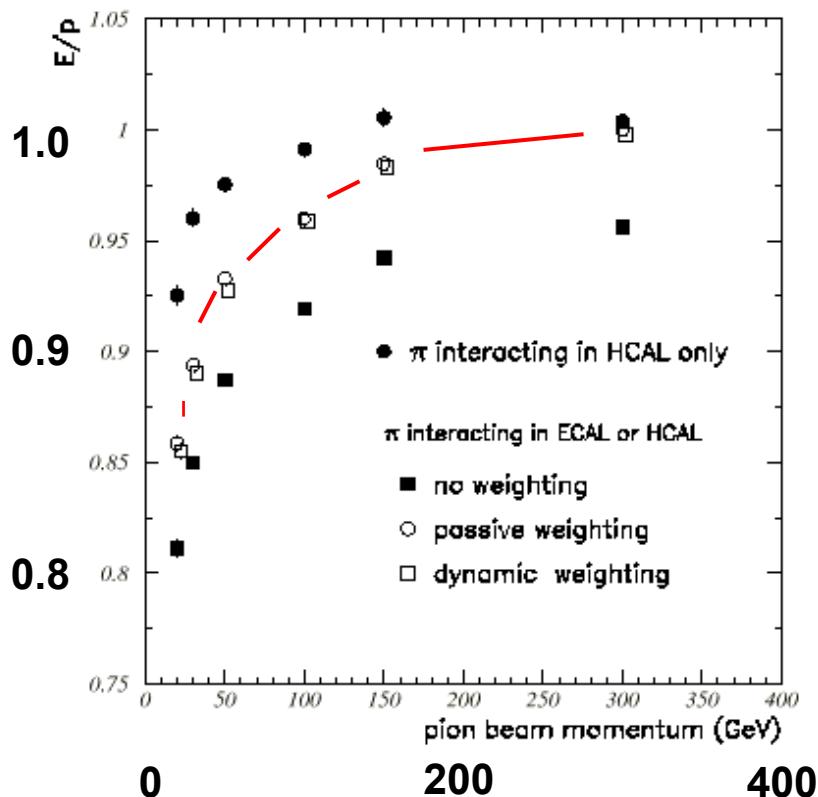
## F) Physics events

- mip signal, link to HO  
muon
- calo energy scale (e/pi)  
charged hadron
- physics energy scale  
photon+jet balancing  
Z+jet balancing  
di-jets balancing  
di-jet mass  
W->jj in top decay
- >> non-linear response
- >> pile-up effect



# From Test Beam to CMS

## Test beam data



(Lowest data point 20GeV)

Test beam data with wire source calibration will give energy scale at the beginning of the CMS run.

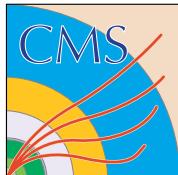
But it has limitation-

Test beam environment does not have B-field and Tracker material.

>> We use MC, initially.

In order to verify MC, we need data points below 15GeV.

>> need "in situ calibration"



# Scenario (HB/HE)

## 1) Before megatile insertion

- megatile scanner: all tiles
- moving wire source: all tiles

(same to HF)

## 2.1) After megatile insertion

- moving wire source: all tiles / 2 layer
- UV laser: 2 layers/wedge

Absolute calib.  
Accuracy of 2%  
for single particle

## 2.2) After megatile insertion

- test beam: a few wedges.

## 3) Before closing the CMS

- moving wire source: all tiles
- UV laser & blue LED: all RBX  
(do 3, about once/year)

Monitor for change  
with time  
Accuracy < 1%

## 4) Beam off times

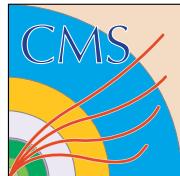
- moving wire source: 2layer/wedge
- UV laser: 2 laer/wedge
- UV laser & blue LED: all RBX

once/month  
a few times/day (?)

## 5) Beam on (in situ)

- jets / tau / MET

ECAL+HCAL



# Test Beam

## Three Goals

1. **Collecting calibration constants**
2. **Prototype of full system.**

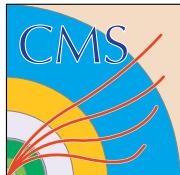
→ Establish a complete data flow and coordination among HCAL subgroups

- Operation of hardware
- Analysis of calibration data and creation of calibration constants
- Creation of the calibration database and maintenance
- Interface to ORCA
- Simulation of test beam setup

→ Define/clarify tasks

3. **Gain experience**

**This year with HB wedges with final electronics?**



# Calibration & Monitoring group

(O.Kodolova)

## Test Beam and initial energy scale

- Requirement for beam test / analysis / source

## Response Equalization (Uniformity + Dead Ch.)

- Source/min-bias/in-situ

## Time Dependence

- Source/laser/LED/min-bias/in-situ

## Data collection and maintenance

- Data type / Data format / file system / database

## Software Tools

- ORCA Interface

## JetMET energy scale

- MC study / In-situ calibration

## Synchronization

A.Yershov  
A.Gribushin  
H.Budd, D.Karmgard  
(HE) (HO)

A.Krokhotine  
K.Teplov  
???

A.Gribushin  
A.Yershov  
(HB) (HE)(HO)

A.Oulianov  
T.Kramer

A.Oulianov  
S.Abdullin

I.Vardanyan  
A.Kokhotine  
P.Hidas  
V.Konnopianikov  
A.Urkinbaev  
R.Vidal, ....

???